CMPE 124 Lab 4: A 4-bit Counter 7-Segment Display

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***Abstract*—The purpose of this lab project is to implement a 7-segments display with the help of our previously implemented 74LS163 counter.**

I. Introduction

This lab project is based on the implementation of a 74LS163 counter, a logical circuit that tracks time by using 8 bits.
We use this clocks' input to count from 0 to 15 and display values from 0 to 9 in a 7-segments display.

II. Design Methodology

For this lab project, we use the 74LS163 4-bit counter. This 4-bits counter requires not only a voltage source—to function—and a clock—to provide it with time input—but also a binary switch, to reset it and ensure the wave functions it outputs are correct. Additionally, although we use a resistor, its value can be changed or ignored; our 1kΩ resistor is part of the circuit to demonstrate that we are not focusing on the input voltage, but on the H and L states instead.
Furthermore, we create a 7-segments display by placing 7 LEDs together, and feed these LEDs with the—processed, via logic gates—clock's output.

A. Parts List

- Clock
- 5V Source
- A 74LS163 counters
- Binary switch
- Resistor
- 7-input AND gates
- A 2-input OR gate
- 8 4-input OR gates
- 4 NOT gates
- 7 LED lights

B. Truth Tables

State	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
q_0	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1
q_1	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
q_2	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
q_3	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1

Figure 1. Truth table for a 74LS163 4-bit counter.

C. Schematics

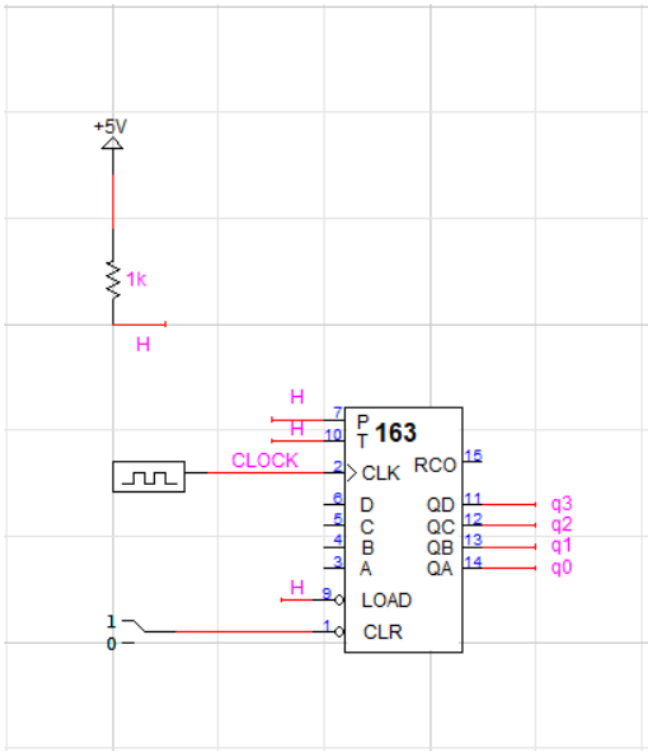

Figure 2. 74LS163 clock-counter circuit scheme.

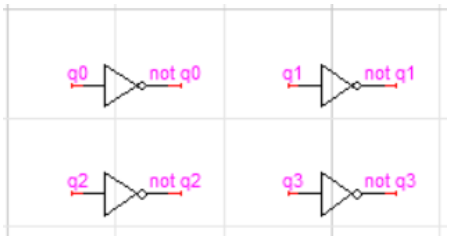

Figure 3. Processing the clock's output.

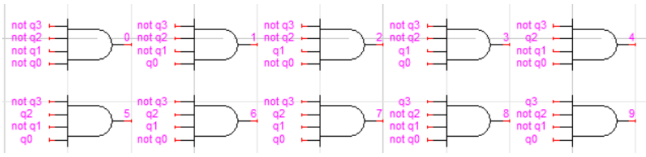

Figure 4. Processing the clock's binary output into decimal values.

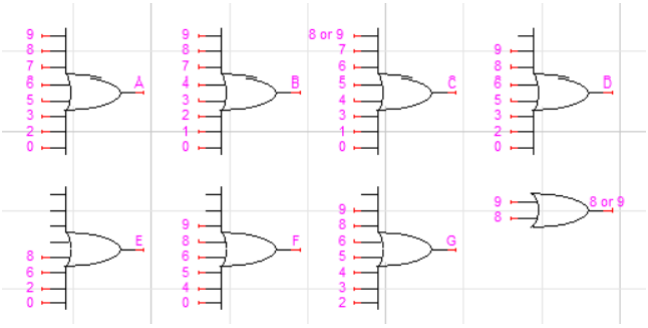

Figure 5. Assigning decimal values to each of the 7 LEDs.

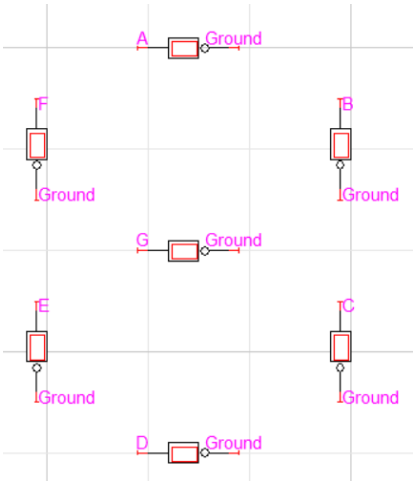

Figure 6. 7 LEDs setup.

III. TESTING PROCEDURES

1. Create a counter as pictured in Figure 3.
2. Set up the logic gates as pictured in Figures 3, 4, and 5.
3. Feed the A, B, C, D, E, F, G outputs to the 7-segments display, as pictured in Figure 6.
4. Reset the clock with a switch and run the simulation.

IV. TESTING RESULTS

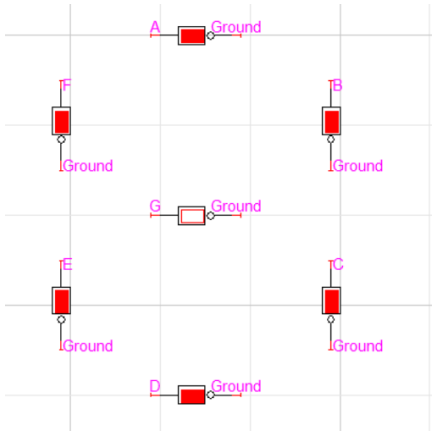

Figure 7. Number 0's representation

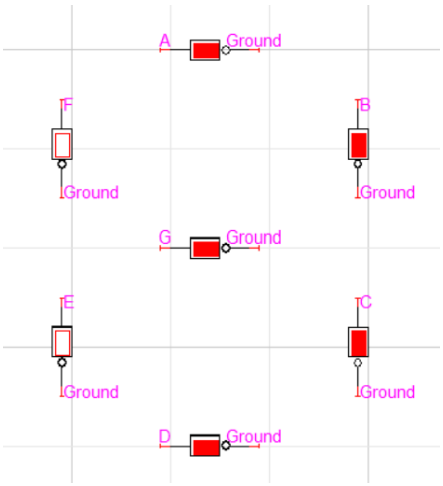

Figure 8. Number 3's representation.

V. CONCLUSION

In conclusion, a 4-bit binary number can be represented by a 74LS163 clock-counter circuit. If we process this output via logic gates—just like we did in our previous lab, when we tried to stop counting once the clocks reached 210—and connect this processed output into the 7-segments display, we can obtain a decimal visual representation of what's happening within our 74LS163 counter.